



AXA
Research Fund
Through Research, Protection



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



**EXCELENCIA
SEVERO
OCHOA**

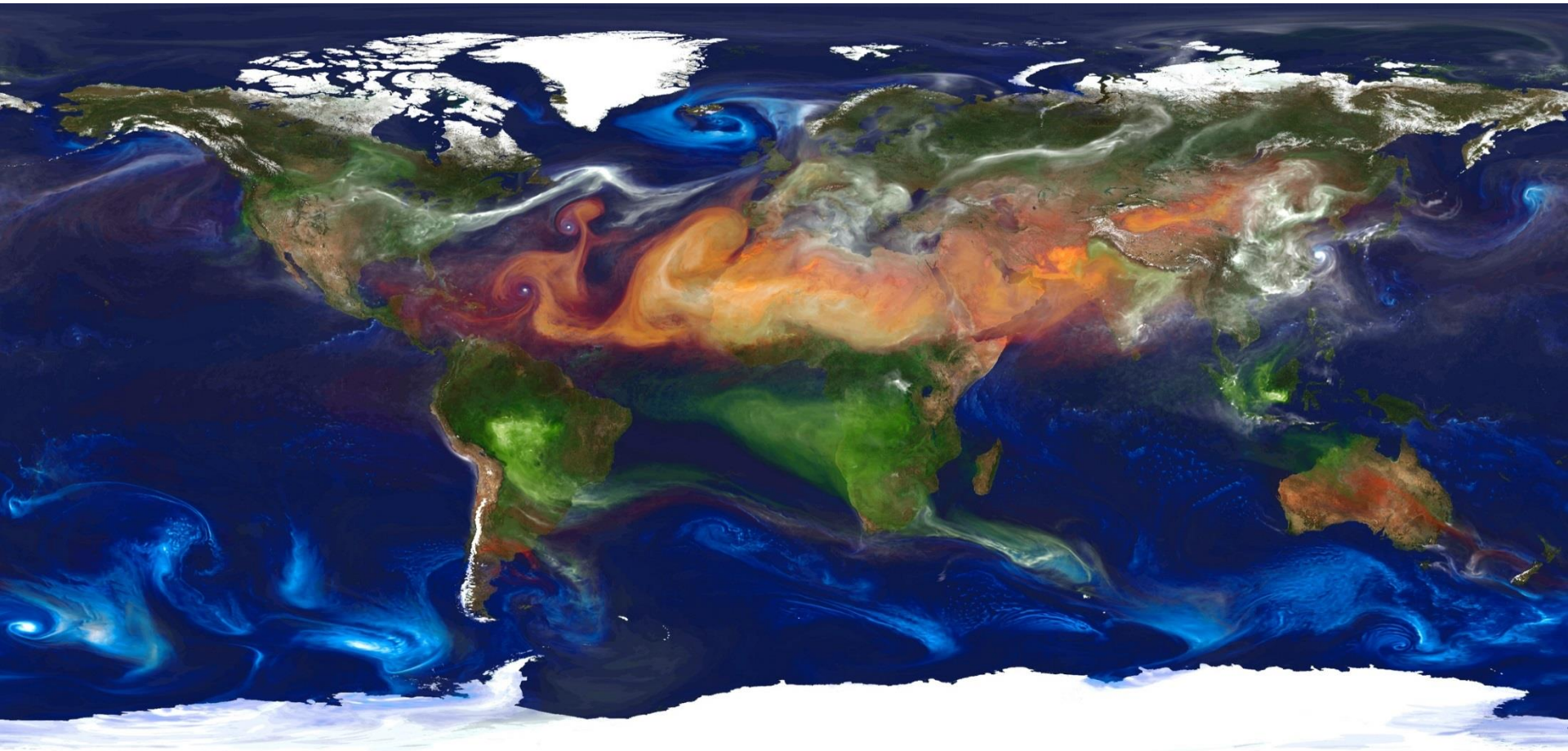
Dust cycle within Earth system

Sara Basart (BSC),
Carlos Pérez García-Pando (BSC)
and Paul Ginoux (NOAA, GFDL)

5th Dec 2019

COP25, Side event, Madrid, Spain

Dust cycle and its extension



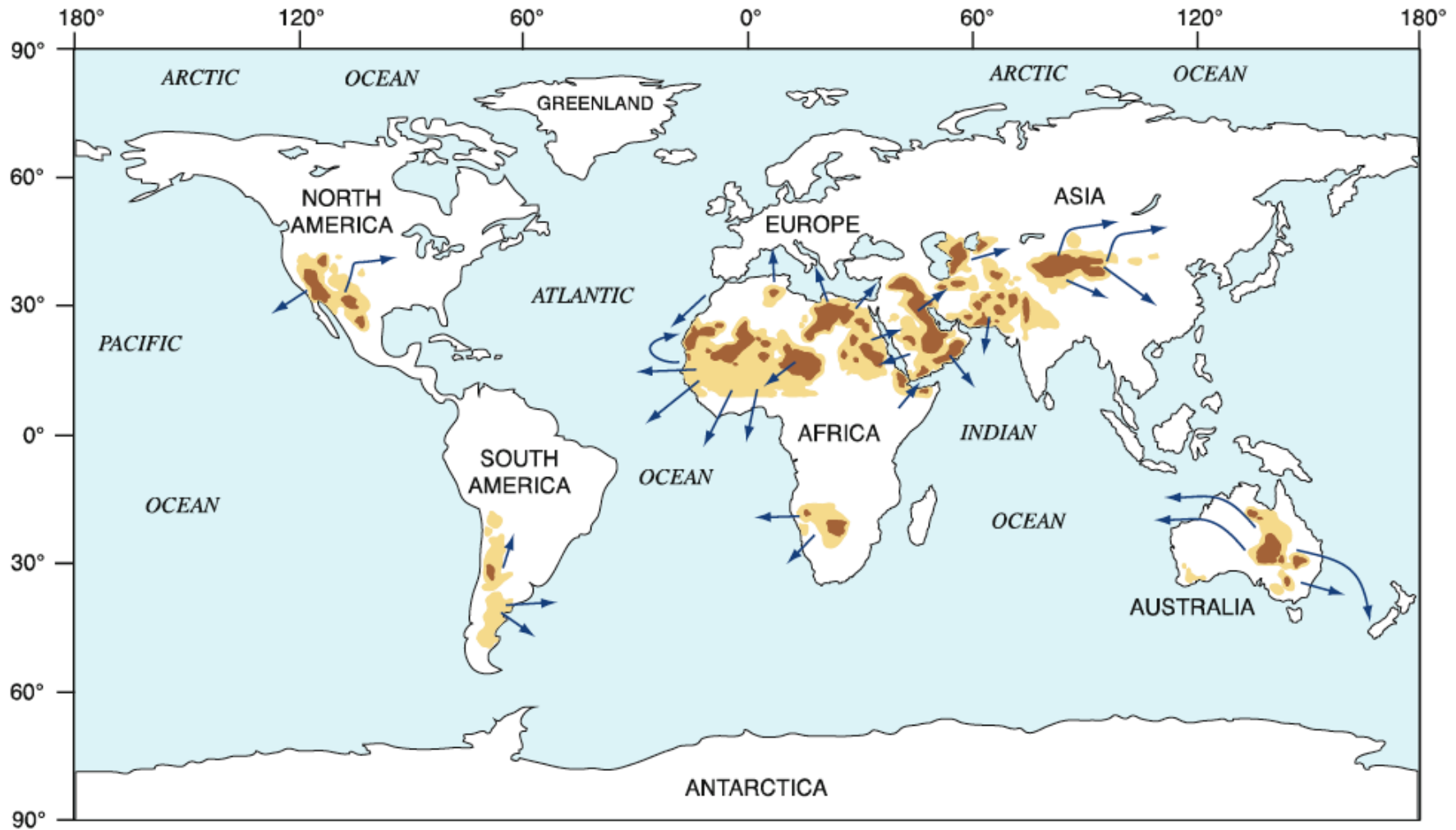
Organic Carbon + Elemental carbon

Dust

Sulfate

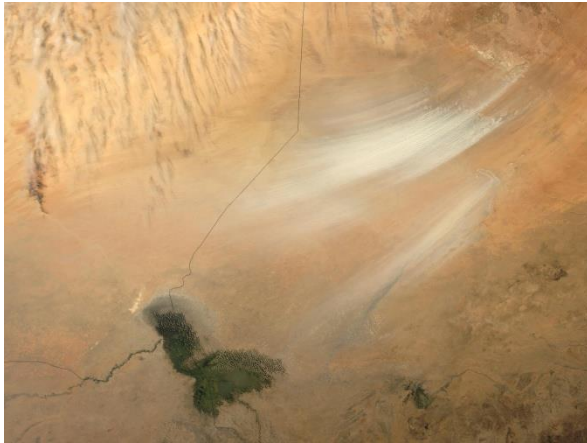
Sea salt

Dust Sources

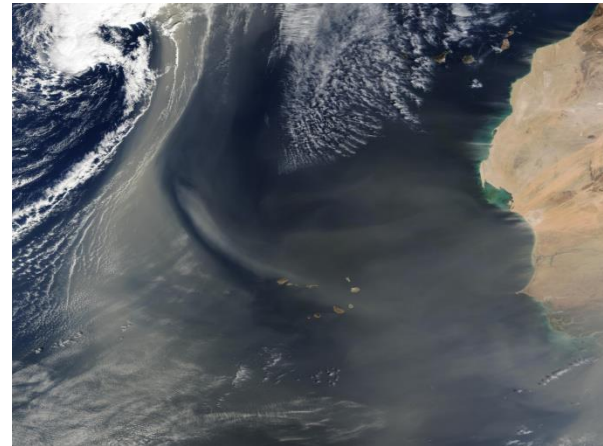


Dust cycle and associated processes

Dust transport is a global phenomenon. However, dust emission is a threshold phenomenon, sporadic and spatially heterogeneous, that is locally controlled on small spatial and temporal scales.



MODIS true colour composite image for March 2005 depicting a dust storm initiated at the Bodélé Depression (Chad Basin)

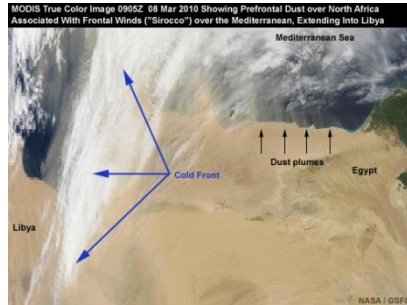


MODIS True color Western Africa – Atlantic Ocean

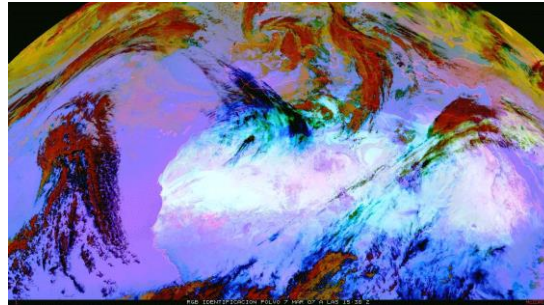
Dust emission, transport and deposition are sensitive to **surface wind speed** and precipitation, among other factors.

Sand and Dust Storms typologies

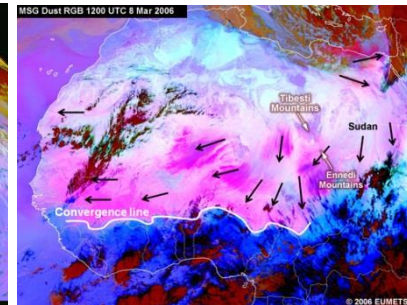
Synoptic dust storms (large scale weather systems)



Pre-frontal winds

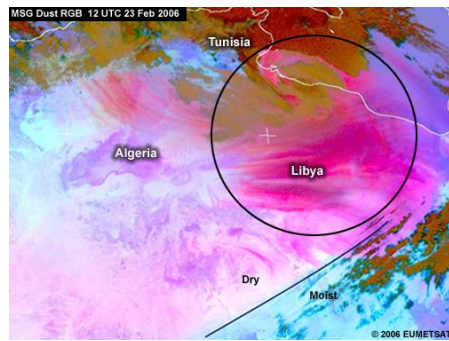


Post-frontal winds

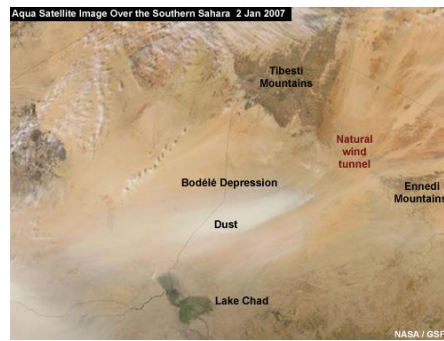


Large-scale trade winds

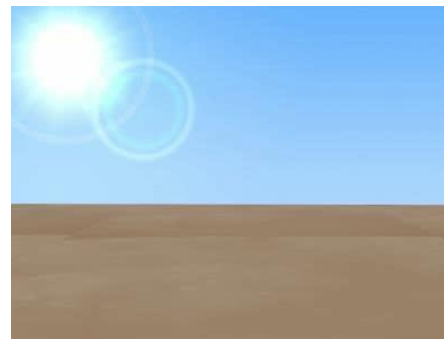
Mesoscale dust storms



Downslope winds



Gap flow

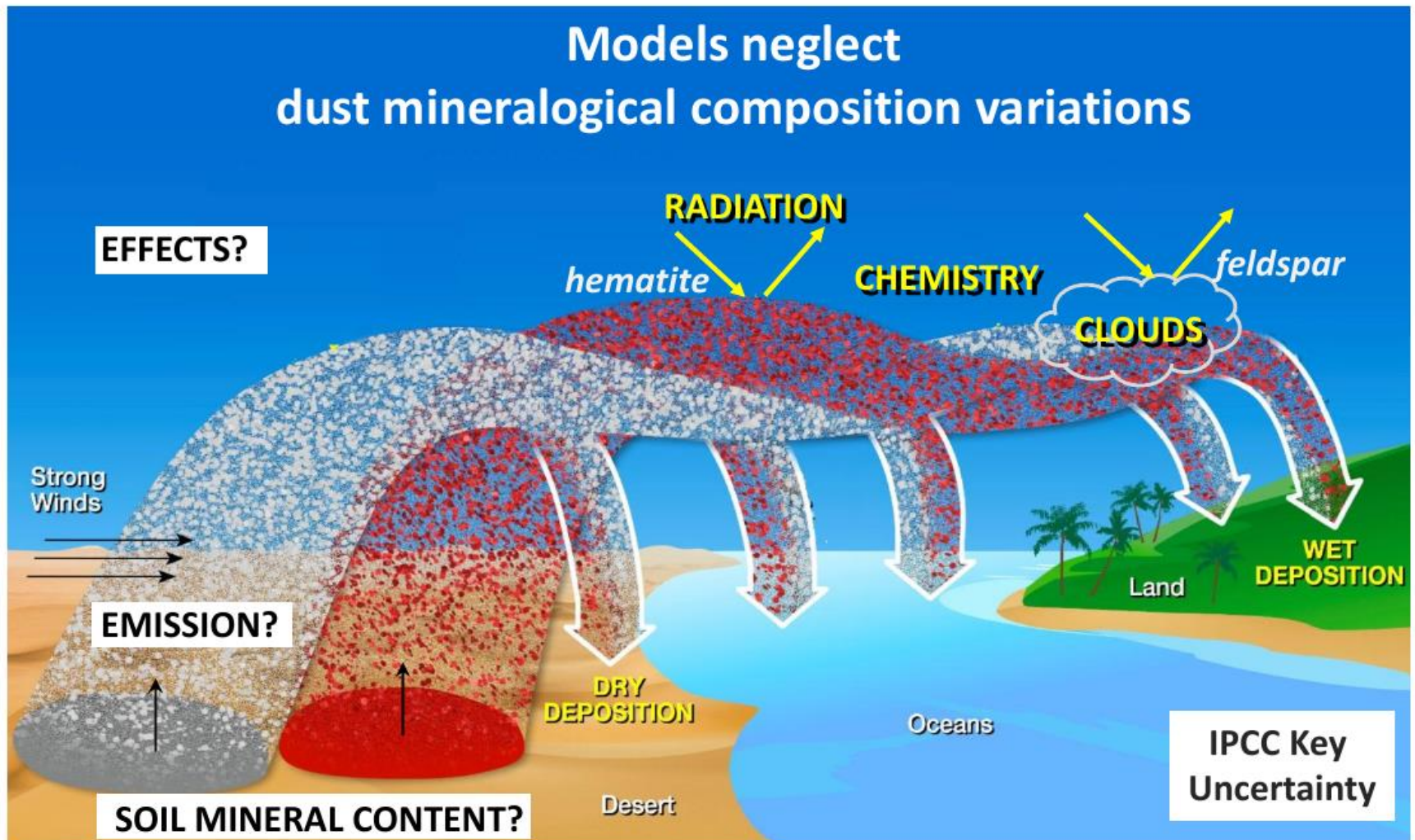


Dust devils



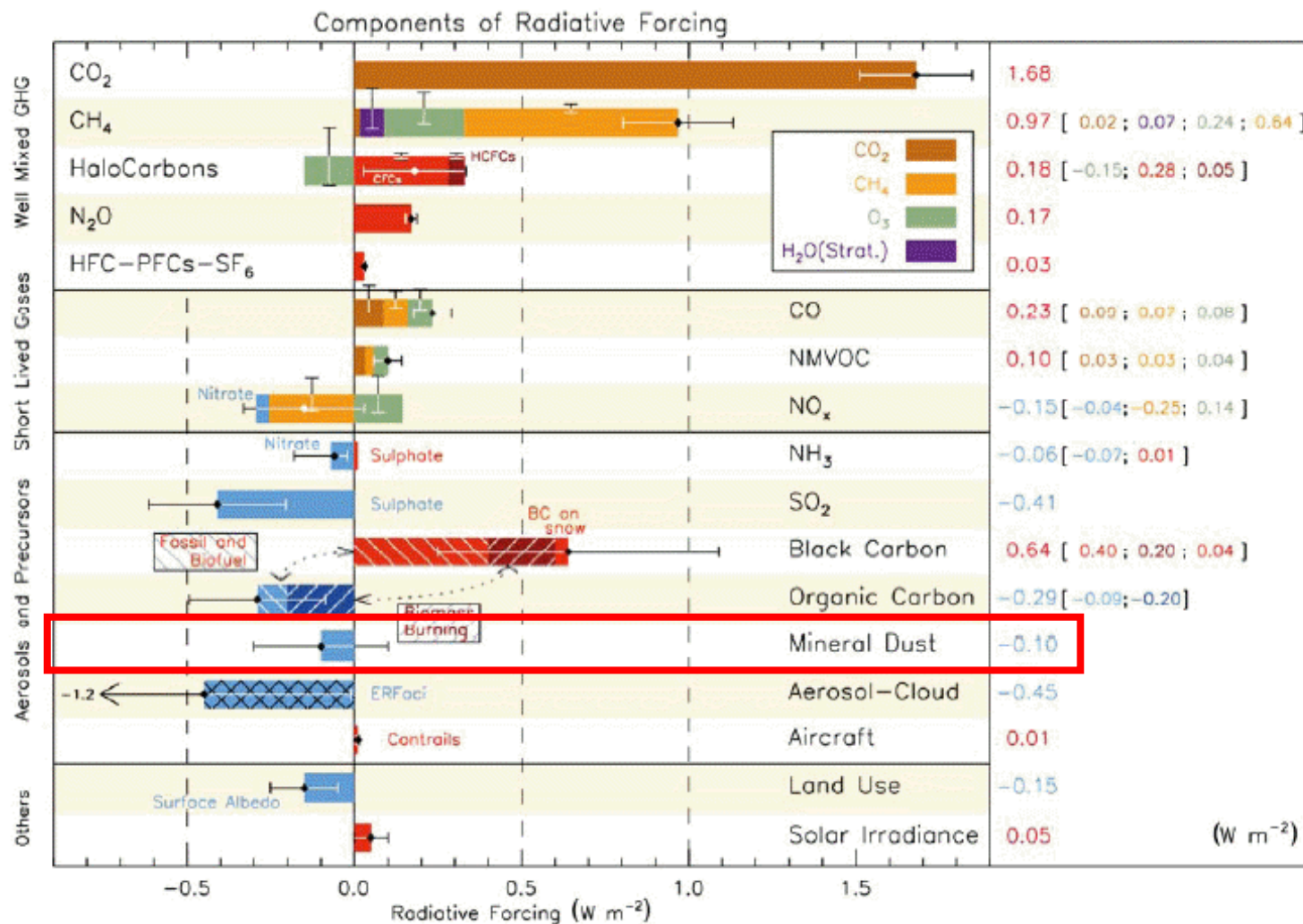
Haboobs

How dust interact with the climate?



SOURCES: HUMAN DISTURBANCES e.g. agriculture

How dust interact with the climate?



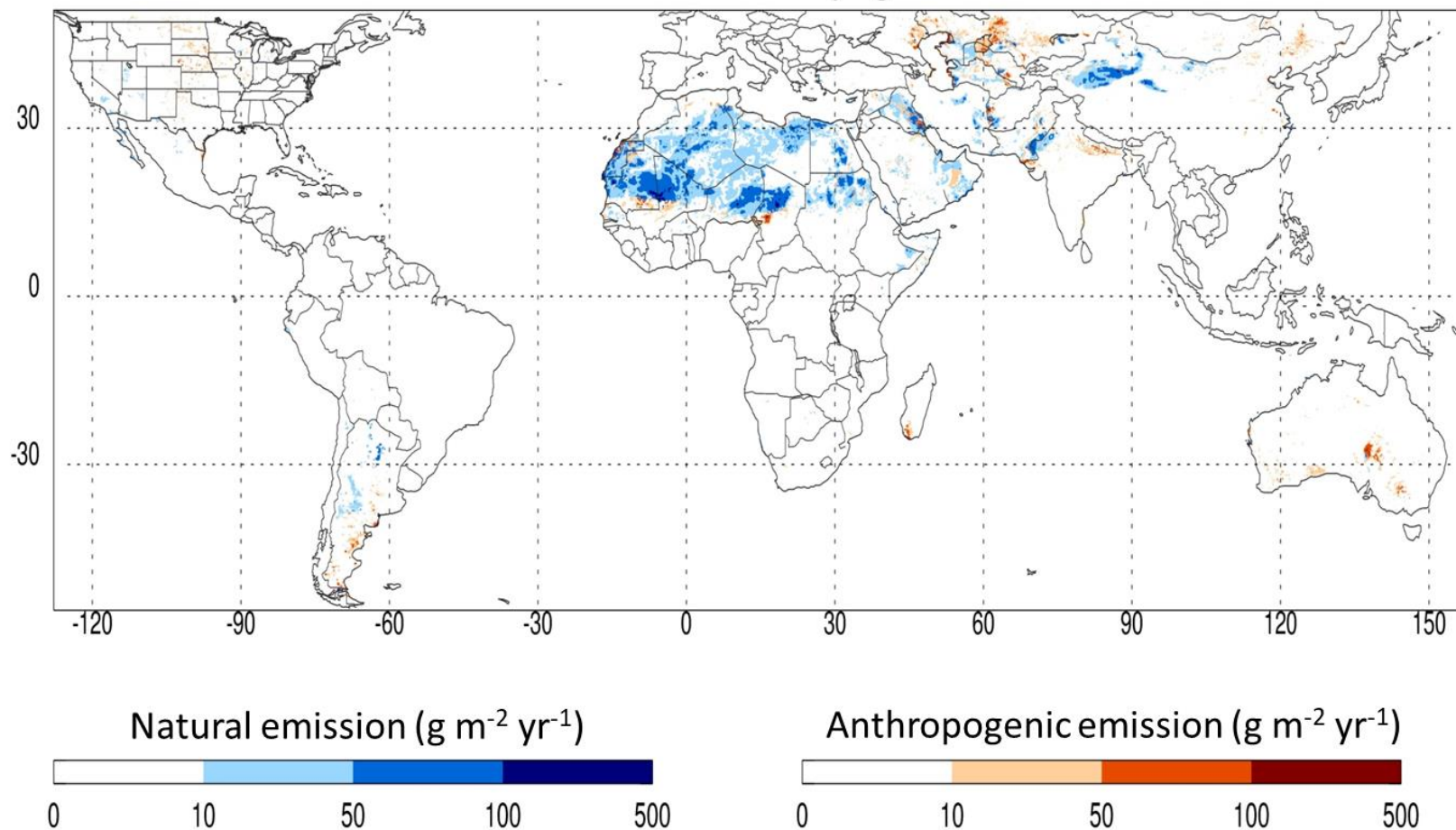
Is it a natural phenomena?

Natural=1173 Tg.yr⁻¹

(~75%)

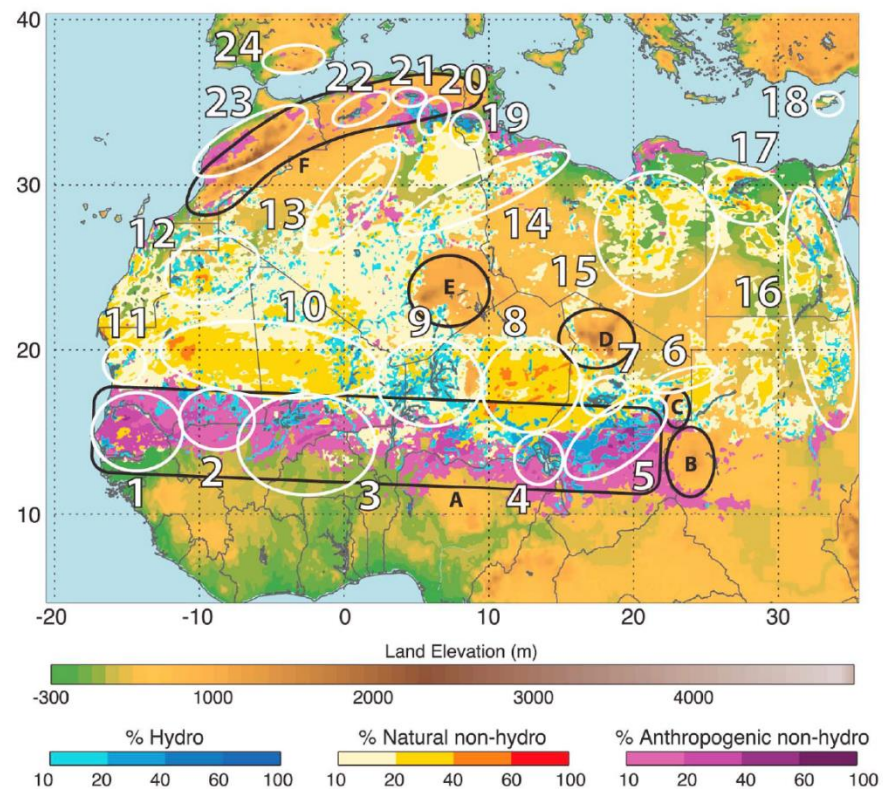
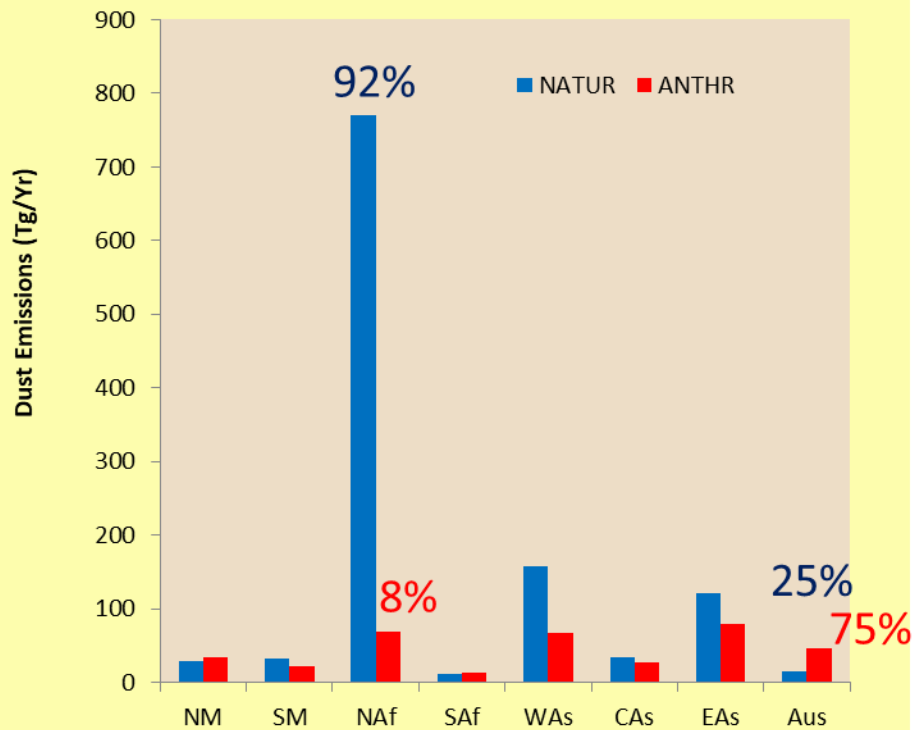
Natural & Anthropogenic (~25%)

Anthro=363 Tg.yr⁻¹



(Ginoux et al., RoG, 2012)

Is it a natural phenomena?



Is it a natural phenomena?

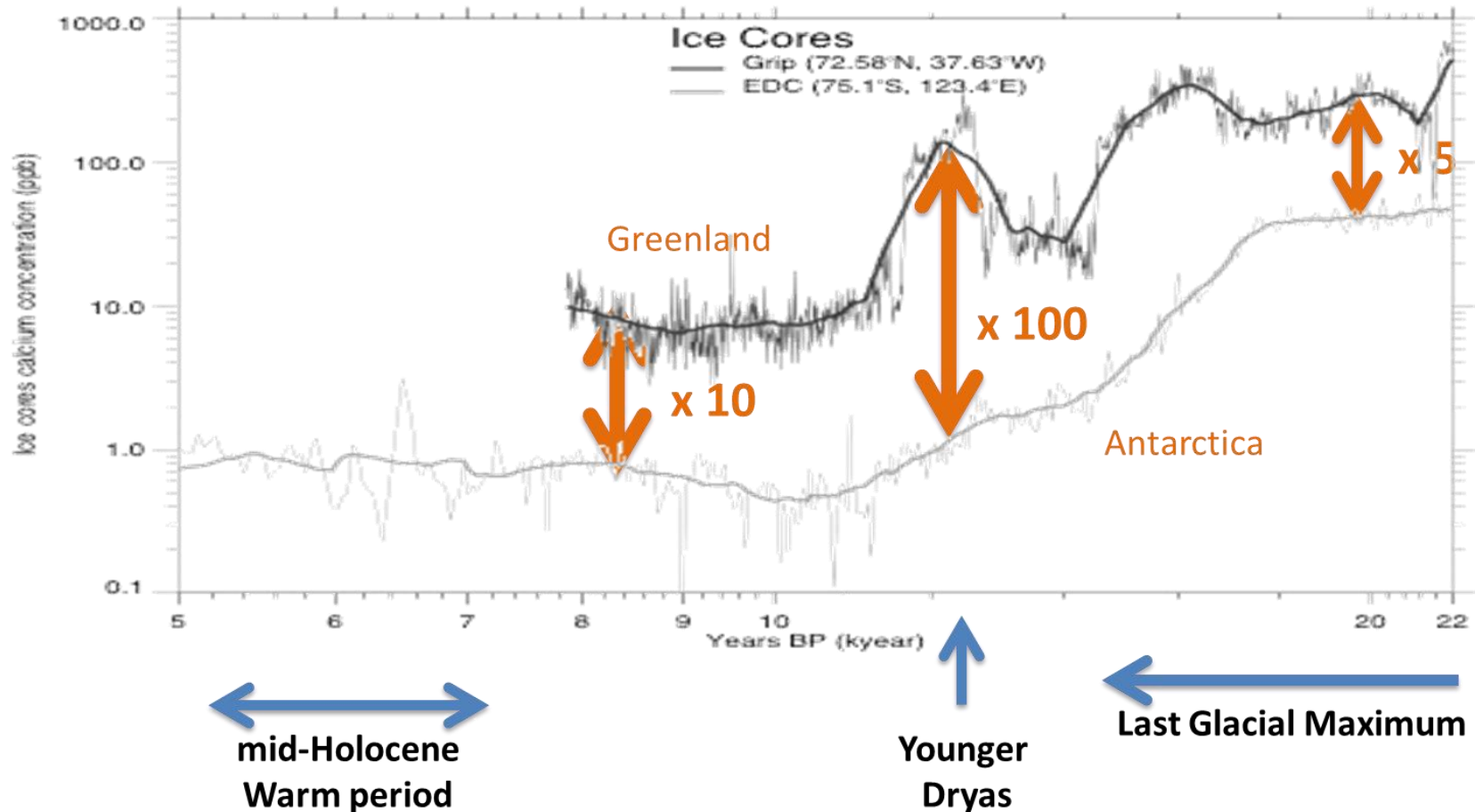


Is it a natural phenomena?



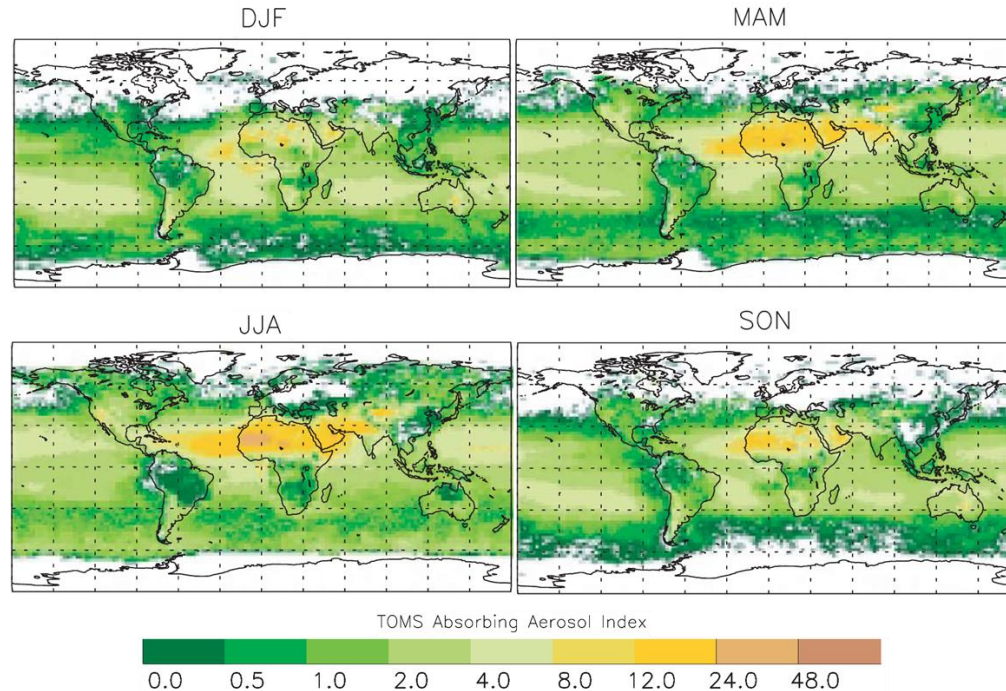
Kathmandu, Nepal, March 2017

Decadal to millennial scale dust variability



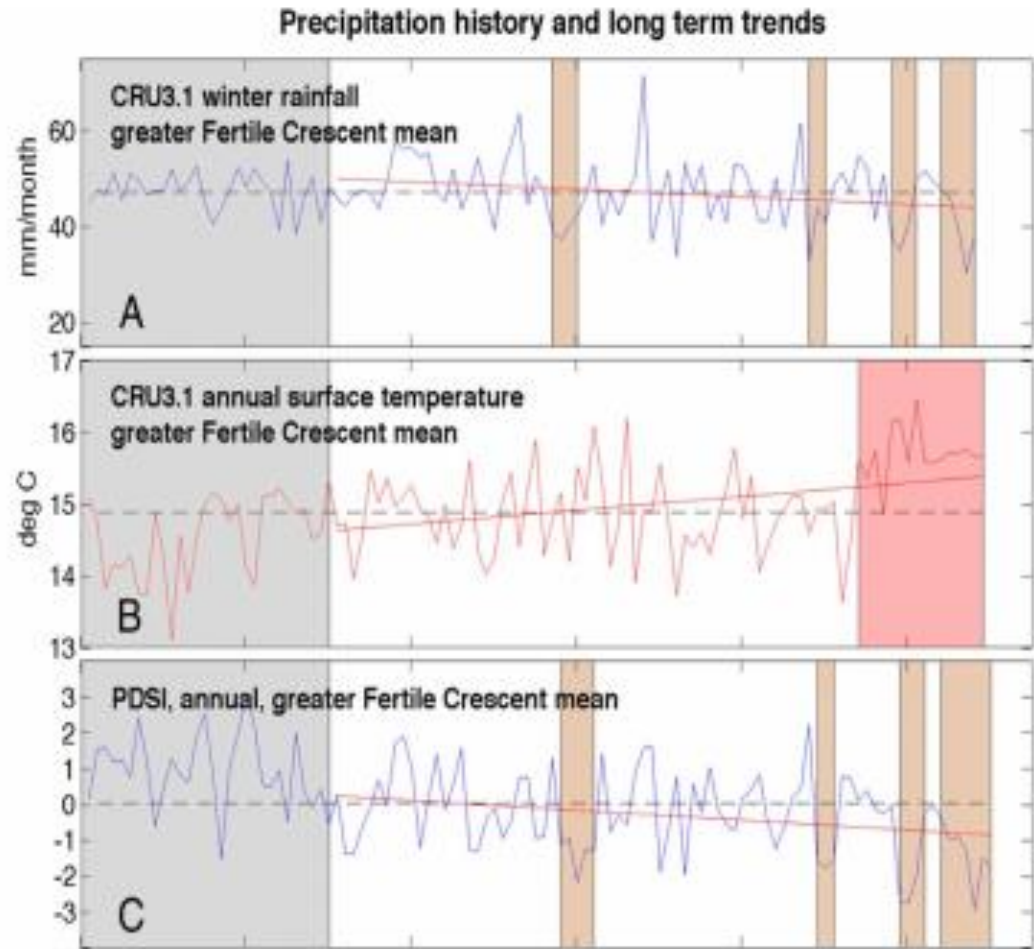
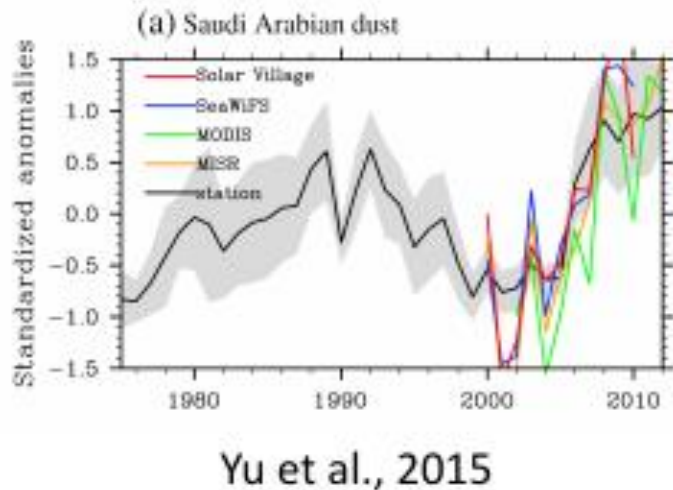
Interannual, decadal and long-term trends

Temporal changes in the dust distribution: SEASONAL and DECADAL CHANGES



- Seasonal dust distribution changes well characterized. Follows seasonal changing weather regimes (mainly) and vegetation changes (in semi-arid areas)
- Interannual/decadal changes are controlled by climate and surface modification (land use, desertification). Decadal changes are not well captured by models

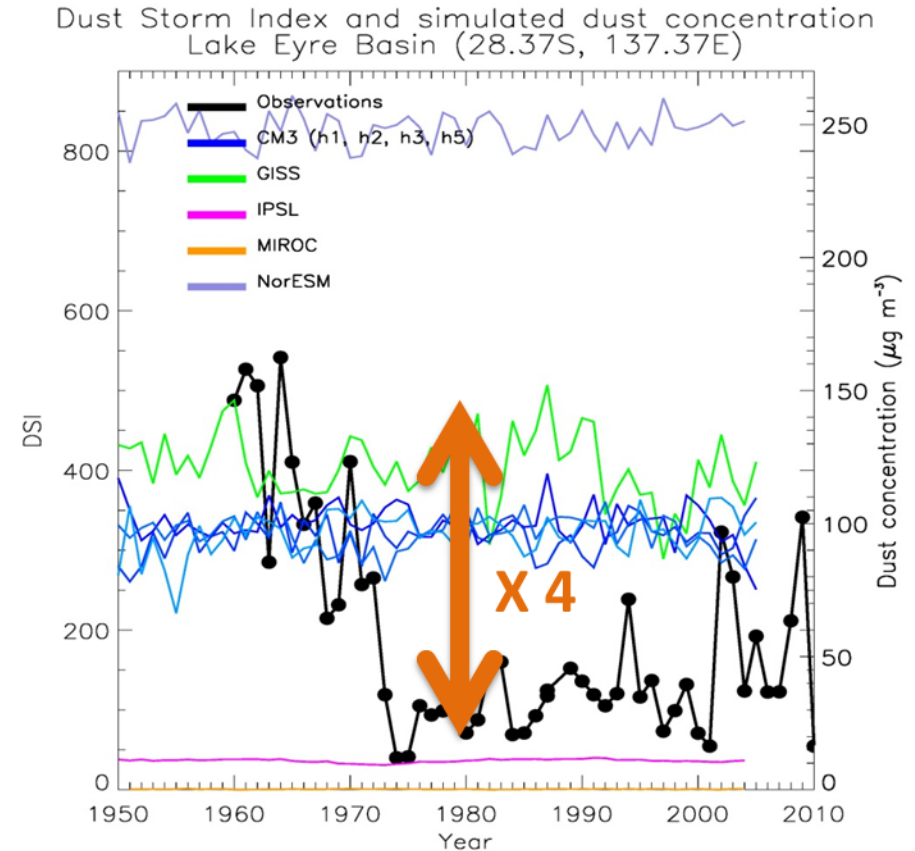
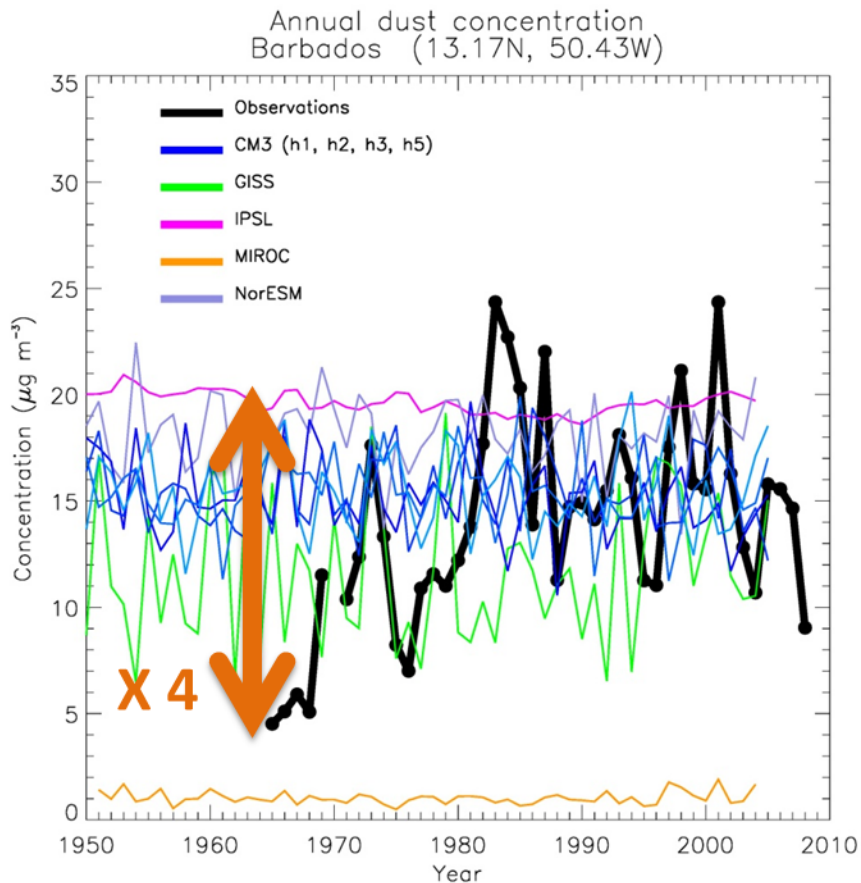
Interannual, decadal and long-term trends



Kelley et al., 2015 PNAS

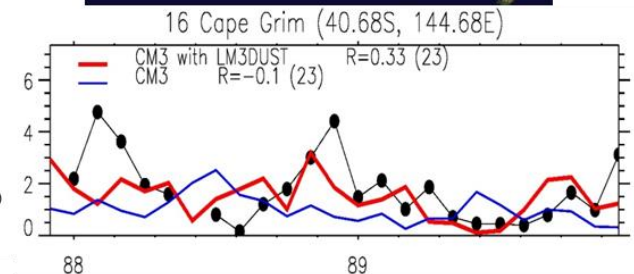
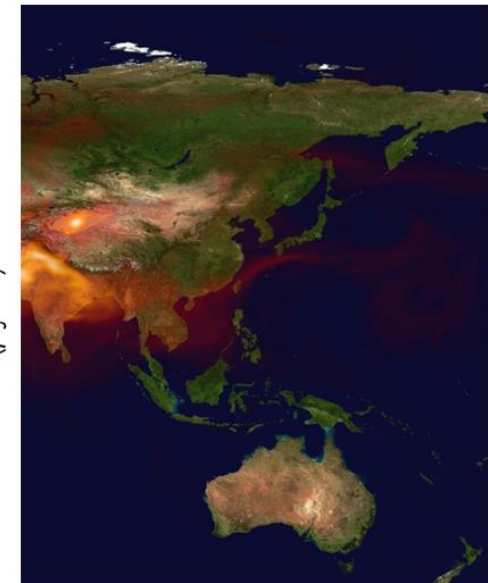
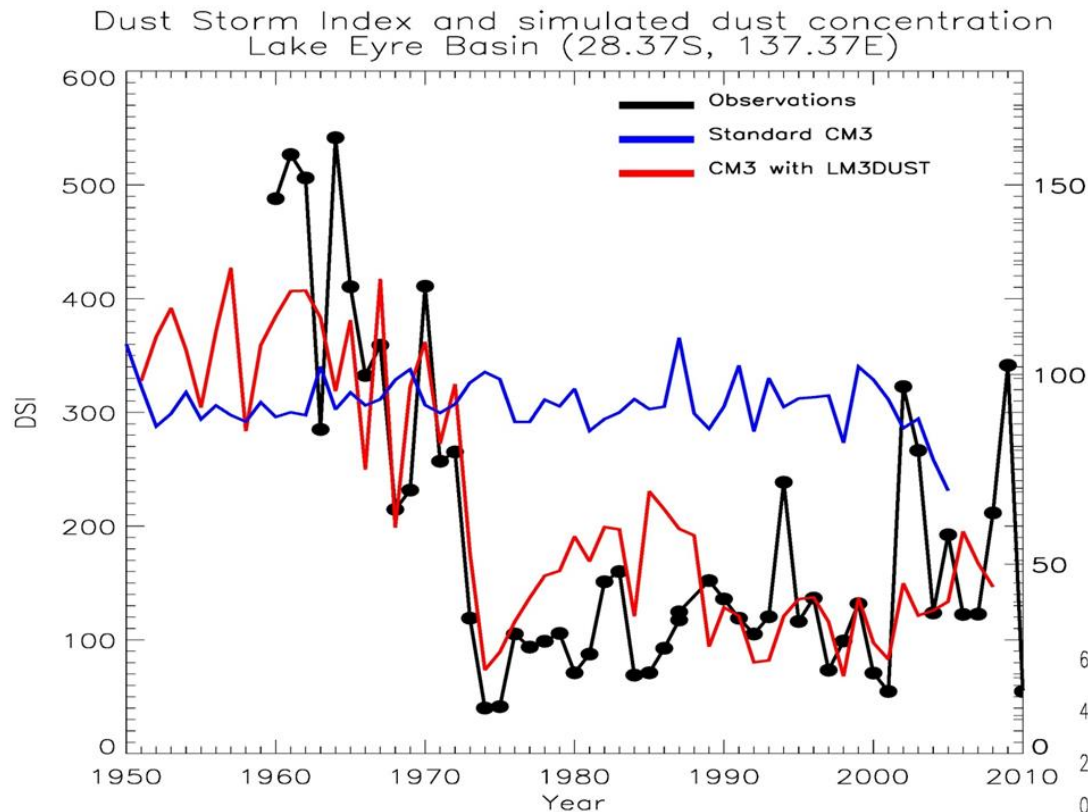
Interannual-decadal variability is closely associated to precipitation, soil moisture and vegetation.

Dust decadal variability with climate models



There is a large spread of results between CMIP5 surface dust concentrations, but they have all a common lack of decadal variability

Connecting dust emission to dynamic vegetation model and land use change



Following heavy precipitation in early 70s, surface dust concentration dropped by a factor 3 in agreement with Dust Storm Index.



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



AXA
Research Fund

inDust



Thank you

sara.basart@bsc.es